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Special Topic: Emerging Pollution and Emerging Pollutants

Emerging pollution and emerging pollutants

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Emerging pollutants/contaminants are usually regarded as naturally or artificially occurring chemicals that are potentially harmful to ecological and/or human health but have not yet been commonly monitored or regulated. Despite the presence of emerging contaminants at a trace level in the environment, they have received extensive attention in recent years owing to their bioaccumulation, persistence, and toxicity. Nowadays, emerging contaminants are continually detected not only in wastewater treatment plants and municipal solid waste treatment/disposal sites but also in the air, soil, and aquatic systems. With the progress in effective pollution control of traditional pollutants, we are facing new challenges concerning the occurrence of emerging contaminants and their resultant pollution, which require endeavors to establish monitoring networks, develop analytical techniques, improve risk assessment models, create novel treatment technologies, and make support decisions.

In this special topic, six high-quality pieces of work have been selected, covering the occurrence, impact, and elimination of emerging contaminants in typical environments.

Gaseous elemental mercury is the main atmospheric Hg species capable of long-distance transportation, transformation, and bioaccumulation, and while particle-bound mercury records the oxidation of elemental mercury, both potentially result in impacts on wildlife and human health. AuYang *et al*. [1] evidence a transition from the equator to the poles of Hg oxidants from OH·/O_3 in the tropics to Br·/Cl·in the polar regions by revealing latitudinal covariations of Hg and S isotopic anomalies in cross-hemispheric marine aerosols, indicating the presence of special oxidation processes producing particle-bound mercury. This study is also significant for understanding the atmospheric Hg, S and N budgets and the aerosol influence on climate and ecosystems.

Ozone (O_3) formed via the photolysis of nitrogen dioxide (NO_2) and volatile organic compounds is one of the main concerns for air quality protection. Wang *et al*. [2] reveal the mechanism of fast photochemical production of secondary pollutants including ozone, indicate the preconditions for rapid O_3 production, elucidate the seasonal fluctuation of photochemical O_3 production in the northern mid-latitude urban areas and stress the importance of the primary radical sources for secondary air pollution control in cool seasons.

The impacts of potential pathogens on drinking water safety have attracted extensive attention. Potential pathogenic bacteria would acquire antibiotic resistance genes and thus perform antibiotic resistance in sterilized or unsterilized drinking water systems. Using 16S rRNA gene amplicon sequencing, Jiang *et al*. [3] provide changing patterns of bacterial community and potentially pathogenic bacteria in full-scale drinking water treatment and distribution systems. In particular, they reveal the roles of water chlorination and distribution in shaping bacterial communities, which is very helpful in controlling the dissemination of potential pathogens and mitigating human health risks.

As the largest reservoirs for disposal of anthropogenic wastes, municipal solid waste landfills are also important sinks of antimicrobial resistances from clinical settings and pharmaceutical and husbandry industries. Wu *et al*. [4] conducted a critical review of antibiotics flux, resistome dynamics, and risk assessment in municipal solid waste landfills and revealed that human-associated waste is the major source of leachate-borne bacteria and antibiotics during a decade-long landfilling process. Municipal solid waste landfills create ideal ecological niches for spreading antibiotic-resistant genes, suggesting feasible approaches are needed urgently to reduce health risks from landfill-specific exposure of antimicrobial resistance to human environments.

Photocatalysis is a promising alternative for air purification. Geng *et al*. [5] provide a comprehensive review of the recent development of photocatalysis for air purification and strategies for regulating reaction pathways. Currently, there is still a gap between research and industrial applications in the field of photocatalytic air purification. For example, solar-driven photocatalysis has great potential because of its broad-spectrum activity for various inorganic to organic pollutants at ambient temperature, while insufficient understanding of the reaction mechanism and the deactivation of photocatalysts restricts its practical application. This review summarizes the application scenarios of photocatalytic air purification and envisages the major challenges for promoting applications of photocatalytic technology in the future.

So far, more than 600 different antibiotics have been used in the field of prevention and therapy of human and animal illnesses worldwide. An overview of antibiotics in global rivers is provided by Li *et al*. [6] with a global dataset (1999–2021) containing more than 90,000 records covering 169 antibiotics and their metabolites in surface water and sediment across 76 countries. They reveal the occurrence of prioritized antibiotics, the main influencing factors, and the hotspots of polluted rivers, and provide a risk-based framework for the prioritization of antibiotics at regional and global levels. This review highlights the importance of the whole-life-cycle management of antibiotics through sectoral, regional, and international collaboration.

Given the limited space of this special topic, we could not expect to see the whole of the achievements; rather, we take a broader view to perceive the tip of the global efforts in response to challenges from emerging contaminants and pollution. Currently, a large number of emerging contaminants with unknown structures and risks are present in the environment. Therefore, greater efforts are needed to address these concerns by promoting interdisciplinary research integrating hydroscience, atmospheric science, edaphology, microbiome, environmental science, ecotoxicology, environmental engineering, socioeconomics, and other relevant disciplines. Meanwhile, the upgradation of pollution control technologies, the innovation of cost-effective processes, and sustainable management strategies also need to be strengthened.

References

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